

Appendix A

Chewuch River

REI Metrics

REACH-BASED ECOSYSTEM INDICATORS (REI) ASSESSMENT

REI metrics provide a consistent means of evaluating biological and physical conditions of a watershed in relation to regional standards and known habitat requirements for aquatic biota. These metrics, along with other scientific evaluations, describe the current quality of stream biophysical conditions and can help guide restoration priorities and alternatives. The REI evaluation for the Chewuch River study area was conducted using field data, observations, and applicable studies produced for the Chewuch River, the Methow Basin, and other regional watersheds. The indicators used in this REI assessment were adapted from previous assessments conducted by the US Bureau of Reclamation for the White Pine Reach of Nason Creek (2009) and from the Preston Reach of the Entiat River (2009). The complete list of REI Metrics and threshold values used in this assessment are included in Table 1.

A total of four REI general indicators were assessed at the tributary scale (Table 1). Three metrics were given the rating of ‘at risk condition’: (1) increase in drainage network/road density, (2) natural/human caused disturbance, and (3) change in peak/base flows. There are 3 primary irrigation diversions in the lower river that deplete baseflows during the summer. Increased road density can be attributed to tributary road networks (>1,000 stream crossings) and roads that parallel both sides of the mainstem channel throughout the study area. The disturbance regime has been influenced by floodplain development in the lower 8 miles, which has affected the structure and function of riparian areas, channel–floodplain connectivity, and off-channel habitats. The temperature metric was given a rating of ‘unacceptable’ due to regular exceedances of state temperature standards.

A total of 11 REI general indicators were assessed at the reach scale (Table 2). The habitat access indicator was rated ‘adequate’ for all reaches as no main channel barriers were found. LWD was consistently given an ‘unacceptable’ condition rating in all reaches with the exception of Reach C9. In Reach C1, two of the 11 indicators were rated ‘unacceptable risk’ and two were rated ‘at risk’, including habitat quality and riparian vegetation characteristics. This reach is adjacent to the town of Winthrop and has been affected by floodplain development and channel modification. Seven categories were found to be in ‘adequate condition’. In Reach C2a, four indicators were rated as ‘at risk’ and two as ‘unacceptable’, with the most impaired characteristics being LWD and riparian vegetation. Substrate, pools, floodplain connectivity, and channel stability were rated as ‘adequate’. In Reach C2b, riparian vegetation, off-channel habitat, and floodplain connectivity were rated ‘at risk’ and LWD was rated as ‘unacceptable’. The remaining seven indicators were rated as ‘adequate’. In Reach C3a, LWD, floodplain connectivity, and canopy cover were given an ‘unacceptable risk’ rating. Lateral bank stability, riparian vegetation structure, and riparian disturbance were rated ‘at risk’; the remaining five indicators were given an ‘adequate condition’ rating. In Reach C3b, all indicators were rated ‘adequate’ except for canopy cover and LWD, which were rated ‘at risk’ and ‘unacceptable’, respectively. Data were not available to assign a riparian vegetation structure rating for Reaches C3b to C9. In Reach C4, five indicators were rated as ‘adequate’. Substrate, off-channel habitat connectivity, and channel migration were rated ‘at risk’; LWD, floodplain connectivity, and canopy cover were rated as ‘unacceptable’. In Reach C5/6, riparian canopy cover, floodplain connectivity, and substrate were rated ‘at risk’ and LWD was ‘unacceptable’. The six remaining indicators received an ‘adequate’ condition rating. In Reach C7, seven of the eleven indicators

were given an 'adequate' condition rating. Riparian canopy cover and pool frequency were rated 'at risk' and LWD was rated 'unacceptable'. Eight indicators were given an 'adequate' condition rating for Reach C8, while LWD and riparian canopy cover were rated as 'unacceptable'. LWD presence was rated 'adequate' in Reach C9. This reach lacks pools, and was given an 'at risk' rating, while canopy cover was rated 'unacceptable'. The remaining indicators were given an 'adequate' condition rating for the reach.

Table 1. REI Metrics used in the Chewuch River Assessment: criteria for condition ratings.

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Watershed condition	Effective Drainage Network and Watershed Road Density	Increase in Drainage Network/Road Density	Zero or minimum increases in active channel length correlated with human caused disturbance. And road density <1 miles/miles ²	Low to moderate increase in active channel length correlated with human caused disturbances. And road density <1 miles/miles ²	Greater than moderate increase in active channel length correlated with human caused disturbances. And road density >2.4 miles/miles ²
	Disturbance Regime	Natural/Human Caused	Environmental disturbance is short lived; predictable hydrograph, high quality habitat and watershed complexity providing refuge and rearing space for all life stages or multiple life-history forms. Natural processes are stable.	Scour events, debris torrents, or catastrophic fires are localized events that occur in several minor parts of the watershed. Resiliency of habitat to recover from environmental disturbance is moderate.	Frequent flood or drought producing highly variable and unpredictable flows, scour events, debris torrents, or high probability of catastrophic fire exists throughout a major portion of the watershed. The channel is simplified, providing little hydraulic complexity in the form of pools or side channels. Natural processes are unstable.
Flow/Hydrology	Streamflow	Change in Peak/Base Flows	Magnitude, timing, duration, and frequency of peak flows within a watershed are not altered relative to natural conditions of an undisturbed watershed of similar size, geology, and geography.	Some evidence of altered magnitude, timing, duration, and/or frequency of peak flows relative to natural conditions of an undisturbed watershed of similar size, geology, and geography.	Pronounced changes in magnitude, timing, duration, and/or frequency of peak flows relative to natural conditions of an undisturbed watershed of similar size, geology, and geography.
Water Quality	Temperature	Daily maximum, and 7-day mean maximum temperatures	Bull Trout: Incubation 2-5°C, rearing: 4-10°C, spawning: 1-9°C. Salmon and Steelhead: Spawning June-Sept 15°C, Sept-May 12°C; rearing 15°C, migration 15°C, adult holding 15°C. Or 7-day daily maximum temperature performance standards: Salmon spawning 13°C, core summer salmonid habitat 16°C. Salmonid spawning, rearing and migration 17.5°C. Salmonid rearing and migration only 17.5°C.	MWMT in reach during the following life history stages: Incubation <2°C or >6°C; rearing <4°C or >13-15°C; spawning <4°C or >10°C. Temperatures in areas used by adults during the local spawning migration sometimes exceed 15°C. Or 7-day average daily maximum temperature standards exceeded by ≤15%.	MWMT in reach during the following life history stages: Incubation <1°C or >6°C; rearing >15°C; spawning <4°C or >10°C. Temperatures in areas used by adults during the local spawning migration sometimes exceed 15°C. Or 7-day average daily maximum temperature standards exceeded by >15%.



Table 1 continued.

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Reach-Scale					
Habitat Access	Physical Barriers	Main Channel Barriers	No man-made barriers present in the mainstem that limit upstream of downstream migration at any flow.	Man-made barriers present in the mainstem that prevent upstream or downstream migration at some flows that are biologically significant.	Man-made barriers present in the mainstem that prevent upstream or downstream migration at multiple or all flows.
Habitat Quality	Substrate	Dominant Substrate/Fine Sediment	Gravels or small cobbles make-up >50% of the bed materials in spawning areas. Reach embeddedness in rearing areas <20%. ≤12% fines (<0.85mm) in spawning gravel or 12% surface fines of ≤6mm	Gravels or small cobbles make-up 30-50% of the bed materials in spawning areas. Reach embeddedness in rearing areas 20-30%. 12-17% fines (<0.85mm) in spawning gravel or 12-20% surface fines of ≤6mm	Gravels or small cobbles make-up <30% of the bed materials in spawning areas. Reach embeddedness in rearing areas >30%. >17% fines (<0.85mm) in spawning gravel or >20% surface fines of ≤6mm
	LWD	Pieces per Mile at Bankfull	>20 pieces/mile >12" diameter > 35 ft length; and adequate sources of woody debris available for both long- and short-term recruitment.	Currently levels are being maintained at minimum levels desired for "adequate", but potential sources for long-term woody debris recruitment is lacking to maintain these minimum values.	Current levels are not at those desired values for "adequate", and potential sources of woody debris for short- and/or long-term recruitment are lacking.
	Pools	Pool Frequency and Quality, presence of large pools.	Pool frequency: Number of pools/mile for a given channel width. Channel width between 40-65 ft = 9 pools/mile. Channel width 65-100 ft = 4 pools per mile. Pools have good cover and cool water and only minor reduction in pool volume by fine sediment. Each reach has many large pools >1 m deep with good fish cover.	Pool frequency is similar to values in "functioning adequately", but pools have inadequate cover/temperature and/or there has been a moderate reduction of pool volume by fine sediment. Reaches have few large pools (>1m) present with good fish cover.	Pool frequency is considerably lower than values for "adequate condition", also cover/temperature is inadequate, and there has been a major reduction of pool volume by fine sediment. Reaches have no deep pools (>1m) with good fish cover.
	Off-Channel Habitat	Connectivity with Main Channel	Reach has many ponds, oxbows, backwaters, and other off-channel areas with cover, and side channels are low energy areas. No manmade barriers present along the mainstem that prevent access to off-channel areas.	Reach has some ponds, oxbows, backwaters, and other off-channel areas with cover, and side channels are high energy areas. Manmade barriers present that prevent access to off-channel habitat at some flows that are biologically significant.	Reach has few or no ponds, oxbows, backwaters, and other off-channel areas. Manmade barriers present that prevent access to off-channel habitat at multiple or all flows.



Table 1 continued.

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
<i>Reach-Scale</i>					
Channel	Dynamics	Floodplain Connectivity	Floodplain areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland functions, riparian vegetation and succession.	Reduced linkage of wetland, floodplains and riparian areas to main channel; overbank flows are reduced relative to historic frequency, as evidenced by moderate degradation of wetland function, riparian vegetation/succession.	Sever reduction in hydrologic connectivity between off-channel, wetland, floodplain and riparian areas; wetland extent drastically reduced and riparian vegetation/succession altered significantly.
		Bank Stability/Channel Migration	Channel is migrating at or near natural rates.	Limited amount of channel migration is occurring at a faster/slower rate relative to natural rates, but significant change in channel width or planform is not detectable; large woody debris is still being recruited.	Little or no channel migration is occurring because of human actions preventing reworking of the floodplain and large woody debris recruitment; or channel migration is occurring at an accelerated rate such that channel width has at least doubled, possibly resulting in a channel planform change, and sediment supply has noticeably increased from bank erosion.
		Vertical Channel Stability	No measurable trend of aggradation or incision and no visible change in channel planform.	Measurable trend of aggradation or incision that has the potential to, but not yet caused, disconnection of the floodplain or a visible change in channel planform (e.g. single thread to braided)	Enough incision that the floodplain and off-channel habitat areas have been disconnected; or, enough aggradation that a visible change in channel planform has occurred (e.g. single thread to braided).
Riparian Vegetation	Condition	Structure	>80% species composition, seral stage, and structural complexity are consistent with potential native community.	50-80% species composition, seral stage, and structural complexity are consistent with potential native community.	<50% species composition, seral stage, and structural complexity are consistent with potential native community.
		Disturbance (Human)	>80% mature trees (medium-large) in the riparian buffer zone (defined as a 30 m belt along each bank) that are available for recruitment by the river via channel migration; <20% disturbance in the floodplain (e.g., agriculture, residential, roads, etc.); <2 mi/mi ² road density in the floodplain.	50-80% mature trees (medium-large) in the riparian buffer zone (defined as a 30 m belt along each bank) that are available for recruitment by the river via channel migration; 20-50% disturbance in the floodplain (e.g., agriculture, residential, roads, etc.); 2-3 mi/mi ² road density in the floodplain.	<50% mature trees (medium-large) in the riparian buffer zone (defined as a 30 m belt along each bank) that are available for recruitment by the river via channel migration; >50% disturbance in the floodplain (e.g., agriculture, residential, roads, etc.); >3 mi/mi ² road density in the floodplain.



Table 2. REI Metrics: Tributary Scale

General Characteristics	General Indicators	Specific Indicators	Rating	Discussion
<i>Tributary Scale¹</i>				
Watershed condition	Effective Drainage Network and Watershed Road Density	Increase in Drainage Network/Road Density	At Risk	Road density is <2mi/mi ² . There are roads parallel to the channel on both sides of the lower river. Road density is high in tributaries below RM 24.3 (BOR 2008b). There are approximately 1,000 stream crossings in the Chewuch subwatersheds, which have influenced sediment delivery to streams.
	Disturbance Regime	Natural/Human Caused	At Risk	Anthropogenic disturbance is largely concentrated in the lower 8 miles of the watershed and includes roads, riparian clearing, bank protection, levees, agriculture, recreation, and residential development. These activities have affected the structure and function of riparian areas, channel-floodplain connectivity, and off-channel habitats.
Flow/ Hydrology	Streamflow	Change in Peak/Base Flows	At Risk	Instream flows during the summer are impacted in the lower river by irrigation diversions at RM 0.9 (the Fulton Ditch, on private land), RM 8.3 (the Chewuch Ditch, on private land) and RM 9.4 (the Skyline Ditch, on Forest Service land) (BOR 2008a). Analyses have shown that recent fire events may have shifted runoff timing to earlier in the season, without any noticeable effect on total discharge (USFS 2008). Roads in the Chewuch Basin may have some influence on runoff patterns and timing, but specific alterations to the hydrologic regime have not been documented.
Water Quality	Temperature	Daily maximum, and 7-day mean maximum temperatures	Unacceptable	Water temperatures in the Chewuch regularly exceed national and state-level thresholds for salmonids (BOR 2008a and USFS 2008). The Washington State maximum of 16 C was exceeded on 57 days at the mouth, 50 days at RM 12.2, and 19 days at RM 24.8. The NOAA maximum of 14 C is surpassed during the hottest months of the year (BOR 2008A and USFS 2008).

¹ Turbidity and Chemical (Metals/Pollutants/pH) ratings were not included due to a lack of data.



Table 3. REI Metrics: Reach Scale

General Characteristics	General Indicators	Specific Indicators	Reach C1 Condition	Reach C2a Condition	Reach C2b Condition
Habitat Access	Physical Barriers	Main Channel Barriers	<u>Adequate</u> No barriers present.	<u>At Risk</u> No barriers present.	<u>Adequate</u> No barriers present.
Habitat Quality	Substrate	Dominant Substrate/Fine Sediment	<u>At Risk</u> Substrate is composed of 44% gravel and cobble; with 22% sand. 56% of pool crests are embedded with fine sediments (BOR 2008a).	<u>Adequate</u> Substrate is composed of 72% gravel and cobble; with 20% sand. 31% of pool crests are embedded (BOR 2008a).	<u>Adequate</u> Substrate is composed of 78% gravel and cobble; with 13% sand. 28% of pool crests are embedded with fine sediments (BOR 2008a).
	LWD	Pieces per Mile at Bankfull	<u>Unacceptable</u> LWD is scarce in Reach C1 with 5.5 pieces per mile (BOR 2008a).	<u>Unacceptable</u> There are 17.2 pieces of LWD per mile. Recruitment sources for LWD are limited (BOR 2008a).	<u>Unacceptable</u> There are 18.6 pieces of LWD per mile. Recruitment sources for LWD are limited (BOR 2008a).
	Pools	Pool Frequency and Quality	<u>Adequate</u> There are 4.5 pools per mile in Reach C1, and a reach average wetted width of 79 ft (BOR 2008a).	<u>Adequate</u> There are 10.5 pools per mile in Reach C2a, and a reach average wetted width of 76 ft (BOR 2008a).	<u>Adequate</u> There are 9 pools per mile in Reach C2b, and a reach average wetted width of 74 ft (BOR 2008a).



Table 3. REI Metrics: Reach Scale continued.

General Characteristics	General Indicators	Specific Indicators	Reach C1 Condition	Reach C2a Condition	Reach C2b Condition
	Off-Channel Habitat	Connectivity with Main Channel	<u>Adequate</u> Off-channel habitat is naturally limited due to the presence of bedrock and natural channel confinement.	<u>At Risk</u> Reach C2a is low gradient and has <3% side channel habitat (by area) with 5 side channels active at low flow. There are occasional manmade features that may limit access to off-channel areas at some flows.	<u>At Risk</u> Reach C2b has a narrower floodplain, limiting side channel habitat to 1.8% of all habitat area. Two side channels are active at low flow. There are occasional manmade features that may limit access to off-channel areas at some flows.
Channel	Dynamics	Floodplain Connectivity	<u>Adequate</u> Floodplain connectivity is limited in this naturally confined reach. Floodplain connectivity has not been significantly altered from the historical condition.	<u>At Risk</u> 20% of outer zone (floodplain) sub-units are considered “disconnected” due to human modifications related to residential, agricultural, and recreational (i.e. golf course) uses.	<u>At Risk</u> 13% of outer zone (floodplain) sub-units are considered “disconnected” due to human modifications related to residential uses.
		Bank Stability/ Channel Migration <i>% of bank or floodplain altered calculated using BOR 2008 Human Features GIS data for Reaches C2-C4.</i>	<u>Adequate</u> There are areas of active bank erosion, however, channel migration is limited due to natural confinement.	<u>Adequate</u> Current conditions indicate that despite some riprap installed on the outside edges of the floodplain, the channel is able to maintain natural migration rates. Less than 0.5% of the bank or floodplain surfaces have been altered to prevent channel migration.	<u>At Risk</u> The rate of channel migration has been affected at a number of locations via riprap and levees. Approximately 2% of the bank or floodplain surfaces have been altered to prevent channel migration.



Table 3. REI Metrics: Reach Scale continued.

General Characteristics	General Indicators	Specific Indicators	Reach C1 Condition	Reach C2a Condition	Reach C2b Condition
		Vertical Channel Stability	<u>Adequate</u> Sediment aggradation has occurred throughout the study area in response to post-fire sediment fluxes and tributary delta deposits; however, there appears to be no overall measureable trend in aggradation or incision at the reach-scale.	<u>Adequate</u> Sediment aggradation has occurred throughout the study area in response to post-fire sediment fluxes and tributary delta deposits; however, there appears to be no overall measureable trend in aggradation or incision at the reach-scale.	<u>Adequate</u> Sediment aggradation has occurred throughout the study area in response to post-fire sediment fluxes and tributary delta deposits; however, there appears to be no overall measureable trend in aggradation or incision at the reach-scale.
Riparian Vegetation	Condition	Structure <i>Veg. composition analyzed using BOR vegetation GIS data (BOR 2008b) within a 30 meter buffer</i>	<u>At Risk</u> 50% of riparian vegetation is consistent with potential native community.	<u>At Risk</u> 79% of riparian vegetation is consistent with potential native community.	<u>Adequate</u> 97% of riparian vegetation is consistent with potential native community.
		Disturbance (Human) <i>C1-C6 based on BOR 2008b, C7-C9 based on aerial photo analysis.</i>	<u>Adequate</u> <20% of the floodplain vegetation has been cleared.	<u>At Risk</u> 25% of the floodplain vegetation has been cleared.	<u>Adequate</u> There has been minimal clearing of floodplain vegetation.
		Canopy Cover <i>Based on WFPB 1993 air photo analysis method.</i>	<u>Unacceptable</u> Riparian vegetation provides <50% canopy cover, and limited thermal shading.	<u>Unacceptable</u> Riparian vegetation provides <50% canopy cover, and limited thermal shading.	<u>At Risk</u> Riparian vegetation provides 50-80% canopy cover, and moderate thermal shading.



Table 3. REI Metrics: Reach Scale continued.

General Characteristics	General Indicators	Specific Indicators	Reach C3a Condition	Reach C3b Condition	Reach C4 Condition
Habitat Access	Physical Barriers	Main Channel Barriers	<u>Adequate</u> No barriers present.	<u>Adequate</u> No barriers present.	<u>Adequate</u> No barriers present.
Habitat Quality	Substrate	Dominant Substrate/Fine Sediment	<u>Adequate</u> Substrate is composed of 65% gravel and gobbler, with 10% sand. 12% of pools are embedded with fine sediments (BOR 2008a).	<u>Adequate</u> Substrate is composed of 49% gravel and cobble, with 7% sand. 25% of pools are embedded with fine sediments (BOR 2008a).	<u>At Risk</u> Substrate is composed of 77% gravel and cobble, with 20% sand. 39% of pools are embedded with fine sediments (USFS 2008).
	LWD	Pieces per Mile at Bankfull	<u>Unacceptable</u> 9.1 pieces LWD per mile. Future sources for LWD are limited (BOR 2008a).	<u>Unacceptable</u> 7.5 pieces LWD per mile. Future sources for LWD are limited (BOR 2008a).	<u>Unacceptable</u> 5.8 pieces LWD per mile. Future sources for LWD are limited (USFS 2008).
	Pools	Pool Frequency and Quality	<u>Adequate</u> There are 6.1 pools per mile in Reach C3a, and a reach average wetted width of 68 ft (BOR 2008a).	<u>Adequate</u> There are 7.5 pools per mile in Reach C3b, and a reach average wetted width of 67 ft (BOR 2008a).	<u>Adequate</u> There are 8 pools per mile in the reach. Pools are generally deeper in Reach C4 compared to other reaches (USFS 2008).



Table 3. REI Metrics: Reach Scale continued.

General Characteristics	General Indicators	Specific Indicators	Reach C3a Condition	Reach C3b Condition	Reach C4 Condition
	Off-Channel Habitat	Connectivity with Main Channel	<u>At Risk Condition</u> There is one side channel providing high quality rearing habitat in Reach C3a. Human alterations in this reach have influenced lateral connectivity. There are occasional manmade features that may limit access to off-channel areas at some flows.	<u>Adequate</u> Reach C3b is entrenched, however an artificial channel improved by a 2008 BOR project has created off-channel rearing habitat. Side channel habitat comprises 24% of habitat area in the reach.	<u>At Risk</u> There is infrequent off-channel and side channel habitat in this reach. Connectivity between the channel and off-channel areas has been impaired as a result of bank armoring, floodplain filling, and roadways.
Channel	Dynamics	Floodplain Connectivity	<u>Unacceptable</u> 69% of outer zone (floodplain) sub-units are considered “disconnected” due to human modifications related to residential uses, agricultural uses, and roadways/bridges.	<u>Adequate</u> The floodplain is connected to the main channel in this reach and there has been relatively little alteration to floodplain vegetation.	<u>Unacceptable</u> 55% of outer zone (floodplain) sub-units are considered “disconnected” due to human modifications related to residential and agricultural uses. There has been significant clearing and grading of floodplain areas throughout the reach.
		Bank Stability/ Channel Migration <i>% of bank or floodplain altered calculated using BOR 2008 Human Features GIS data for Reaches C2-C4.</i>	<u>At Risk</u> Levees, bank armoring and the bridge at RM 8.3 affect lateral channel migration rates. Approximately 5% of the bank or floodplain surfaces have been altered to limit channel migration.	<u>Adequate</u> The rate of channel migration has been largely unaffected by anthropogenic disturbances in the reach. Approximately 1% of the bank or floodplain surfaces have been altered to limit channel migration.	<u>At Risk</u> There are several locations with bank armoring that affects channel migration rates. Approximately 8% of the bank or floodplain surfaces have been altered to limit channel migration.



Table 3. REI Metrics: Reach Scale continued.

General Characteristics	General Indicators	Specific Indicators	Reach C3a Condition	Reach C3b Condition	Reach C4 Condition
		Vertical Channel Stability	<u>Adequate</u> Sediment aggradation has occurred throughout the study area in response to post-fire sediment fluxes and tributary delta deposits; however, there appears to be no overall measureable trend in aggradation or incision at the reach-scale.	<u>Adequate</u> Sediment aggradation has occurred throughout the study area in response to post-fire sediment fluxes and tributary delta deposits; however, there appears to be no overall measureable trend in aggradation or incision at the reach-scale.	<u>Adequate</u> Sediment aggradation has occurred throughout the study area in response to post-fire sediment fluxes and tributary delta deposits; however, there appears to be no overall measureable trend in aggradation or incision at the reach-scale.
Riparian Vegetation	Condition	Structure <i>Veg. composition analyzed using BOR vegetation GIS data (BOR 2008b) within a 30 meter buffer</i>	<u>At Risk</u> 66% of riparian vegetation is consistent with potential native community.	<u>No Data</u> No Data	<u>No Data</u> No Data
		Disturbance (Human) <i>C1-C6 based on BOR 2008b, C7-C9 based on aerial photo analysis.</i>	<u>At Risk</u> >25% of floodplain vegetation has been cleared.	<u>Adequate</u> <20% of vegetation has been cleared from the floodplain.	<u>Adequate</u> <20% of floodplain vegetation has been cleared.
		Canopy Cover <i>Based on WFPB 1993 air photo analysis method.</i>	<u>Unacceptable</u> Riparian vegetation provides <50% canopy cover, and limited thermal shading.	<u>At Risk</u> Riparian vegetation provides 50-80% canopy cover, and moderate thermal shading.	<u>Unacceptable</u> Riparian vegetation provides <50% canopy cover, and limited thermal shading.



Table 3. REI Metrics: Reach Scale continued.

General Characteristics	General Indicators	Specific Indicators	Reach C5/6 Condition	Reach C7 Condition
Habitat Access	Physical Barriers	Main Channel Barriers	<u>Adequate</u> No barriers present.	<u>Adequate</u> No barriers present.
Habitat Quality	Substrate	Dominant Substrate/Fine Sediment	<u>At Risk</u> Substrate is composed of 79% gravel/cobble, and 20% sand. 15% of pools are embedded with fine sediments (USFS 2008).	<u>Adequate</u> Substrate is composed of 70% gravel/cobble, and 15% sand. 9% of pools are embedded with fine sediments (USFS 2008).
	LWD	Pieces per Mile at Bankfull	<u>Unacceptable</u> Reach C5/6 contains 17.4 pieces LWD per mile (USFS 2008).	<u>Unacceptable</u> Reach C7 contains 4.4 pieces LWD per mile (USFS 2008).
	Pools	Pool Frequency and Quality	<u>Adequate</u> There are 9 pools per mile in Reach C5/6 and an average wetted width of 80 ft (USFS 2008).	<u>At Risk</u> There are 7 pools per mile in Reach C7, with an average wetted width of 75 ft. Pools lack habitat complexity in this reach (USFS 2008).
	Off-Channel Habitat	Connectivity with Main Channel	<u>Adequate</u> There is minimal off-channel habitat in Reach 5/6, however, the upstream portion is naturally narrow with little potential for the development of side-channels. There are no manmade barriers that prevent access to off-channel areas.	<u>Adequate</u> There is limited off-channel habitat in this naturally confined reach. There are no manmade barriers that prevent access to off-channel areas.



Table 3. REI Metrics: Reach Scale continued.

General Characteristics	General Indicators	Specific Indicators	Reach C5/6 Condition	Reach C7 Condition
Channel	Dynamics	Floodplain Connectivity	<u>At Risk</u> 11% of outer zone (floodplain) sub-units are considered “disconnected” due to human modifications related to recreational uses. The primary area of impact is the cleared terrace used for a horse camp near RM 13.8.	<u>Adequate</u> Reach C7 is naturally confined and has a narrow floodplain that maintains surface water connection with the main channel.
		Bank Stability/ Channel Migration	<u>Adequate</u> The rate of channel migration has been largely unaffected by anthropogenic disturbances in the reach.	<u>Adequate</u> The rate of channel migration has been largely unaffected by anthropogenic disturbances in the reach.
		Vertical Channel Stability	<u>Adequate</u> Sediment aggradation has occurred throughout the study area in response to post-fire sediment fluxes and tributary delta deposits; however, there appears to be no overall measureable trend in aggradation or incision at the reach-scale.	<u>Adequate</u> Sediment aggradation has occurred throughout the study area in response to post-fire sediment fluxes and tributary delta deposits; however, there appears to be no overall measureable trend in aggradation or incision at the reach-scale.
Riparian Vegetation	Condition	Structure <i>Veg. composition analyzed using BOR vegetation GIS data (BOR 2008b) within a 30 meter buffer</i>	<u>No Data</u> No Data	<u>No Data</u> No Data



Table 3. REI Metrics: Reach Scale continued.

General Characteristics	General Indicators	Specific Indicators	Reach C5/6 Condition	Reach C7 Condition
		Disturbance (Human) <i>C1-C6 based on BOR 2008b, C7-C9 based on aerial photo analysis.</i>	<u>Adequate</u> <20% of vegetation in the floodplain has been cleared.	<u>Adequate</u> <20% of vegetation in the floodplain has been cleared.
		Canopy Cover <i>Based on WFPB 1993 air photo analysis method.</i>	<u>At Risk</u> Riparian vegetation provides 50-80% canopy cover, and moderate thermal shading.	<u>At Risk</u> Riparian vegetation provides 50-80% canopy cover, and moderate thermal shading.

Table 3. REI Metrics: Reach Scale continued.

General Characteristics	General Indicators	Specific Indicators	Reach C8 Condition	Reach C9 Condition
Habitat Access	Physical Barriers	Main Channel Barriers	<u>Adequate</u> No barriers present.	<u>Adequate</u> No barriers present.
Habitat Quality	Substrate	Dominant Substrate/Fine Sediment	<u>Adequate</u> Substrate is composed of 83% gravel and cobble, with 15% sand. 27% of pools are embedded with fine sediments (USFS 2008).	<u>Adequate</u> Substrate is composed of 72% gravel and cobble, with 11% sand. 19% of pools are embedded with fine sediments (USFS 2008).
	LWD	Pieces per Mile at Bankfull	<u>Unacceptable</u> Reach C8 contains 16.6 pieces LWD per mile (USFS 2008).	<u>Adequate</u> Reach C9 contains 23.7 pieces LWD per mile (USFS 2008).
	Pools	Pool Frequency and Quality	<u>Adequate</u> There are 6.7 pools per mile in Reach C8, and a reach average wetted width of 70 ft (USFS 2008).	<u>At Risk</u> There are 9.5 pools per mile in Reach C9, and a reach average wetted width of 61 ft. Pools are shallower in this reach relative to downstream reaches (USFS 2008).
	Off-Channel Habitat	Connectivity with Main Channel	<u>Adequate</u> There is connected off-channel and side-channel habitat in the reach. There are no manmade barriers that prevent access to off-channel areas.	<u>Adequate</u> High quality off-channel habitat that provides thermal refuge is present and connected to the main channel (USFS 2008). There are no manmade barriers that prevent access to off-channel areas.



Table 3. REI Metrics: Reach Scale continued.

General Characteristics	General Indicators	Specific Indicators	Reach C8 Condition	Reach C9 Condition
Channel	Dynamics	Floodplain Connectivity	<u>Adequate</u> The floodplain is well connected to the main-channel in Reach C8.	<u>Adequate</u> The floodplain is well connected to the main surface flow in Reach C9.
		Bank Stability/ Channel Migration	<u>Adequate</u> The rate of channel migration has been largely unaffected by anthropogenic disturbances in the reach.	<u>Adequate</u> The rate of channel migration has been largely unaffected by anthropogenic disturbances in the reach.
		Vertical Channel Stability	<u>Adequate</u> Aggradation of fine sediment has occurred in this reach, supplied by post-fire sediment fluxes and eroding tributary delta deposits.	<u>Adequate</u> There is no indication of aggradation or incision.
Riparian Vegetation	Condition	Structure Veg. composition analyzed using BOR vegetation GIS data (BOR 2008b) within a 30 meter buffer	<u>No Data</u> No Data	<u>No Data</u> No Data
		Disturbance (Human) C1-C6 based on BOR 2008b, C7-C9 based on aerial photo analysis.	<u>Adequate</u> <20% of vegetation in the floodplain has been cleared.	<u>Adequate</u> <20% of vegetation in the floodplain has been cleared.



Table 3. REI Metrics: Reach Scale continued.

General Characteristics	General Indicators	Specific Indicators	Reach C8 Condition	Reach C9 Condition
		Canopy Cover <i>Based on WFPB 1993 air photo analysis method.</i>	<u>Unacceptable</u> Riparian vegetation provides <50% canopy cover, and limited thermal shading.	<u>Unacceptable</u> Riparian vegetation provides <50% canopy cover, and limited thermal shading.